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### PHOSPHATE DEMONSTRATION IN STEVENS COUNTY IN 1918

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#### PHOSPHATES FOUND PROFITABLE ON MORRIS EXPERIMENTAL FARM

Experiments with acid phosphate alone, rock phosphate alone, manure alone, and each of the two phosphates combined with manure in a four-year rotation of corn, wheat, oats, and clover have been conducted on the West Central experimental farm, at Morris, for the last five years. The soil is a black silt loam with a silt loam subsoil, these being commonly referred to by the farmers as "clay loam" and "clay" respectively. The results have been given in detail in the annual reports of the West Central Experiment Station for 1915, 1916, and 1917.

The results up to the end of 1917 are summarized in the report of the station for 1917 (p. 12), as follows:

"The manure has produced almost as high yields as the combination of manure with either of the two phosphates, and at the cost prices assumed has proved the cheapest fertilizer. Acid phosphate, when used alone, has given almost the same yields as manure alone, except in the case of wheat, where it has given a higher yield. The combination of acid phosphate with manure has produced the same amount of corn, less oats, and more wheat than the manure alone. The value of all four crops together has been only a trifle higher than where the same amount of acid phosphate was used without manure. It is evident that on such soil acid phosphate can not profitably be used where there is sufficient manure to give the land a dressing of 8 tons per acre once in four years. However, where this amount of manure is not available, it would appear decidedly profitable to apply acid phosphate to wheat and clover on the fields which receive no manure. . . .

"It is important at this point to call to the attention of Minnesota readers the fact that altho these experiments appear to leave no doubt as to the value of phosphate fertilizers on such soil as that of the West Central substation, at Morris, which is representative of a great area of western

Minnesota soil, similar experiments being carried on at the experimental farms at St. Paul, Crookston, Waseca, Grand Rapids, and Duluth have so far failed to reveal any such markedly beneficial effect."

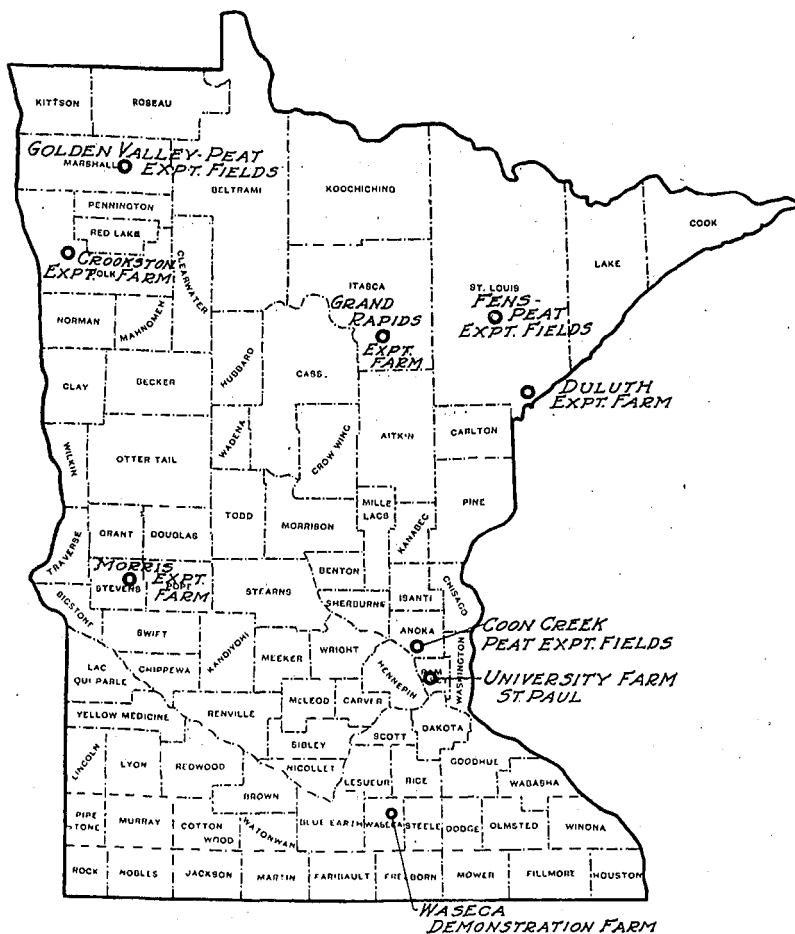


Fig. 1 Location of Experimental Farms

In Table I are shown the average yields obtained by the different treatments, the values of the crops, and the profit or loss occasioned by the fertilizers, using the following prices: Corn 60 cents per bushel, wheat \$1, oats 40 cents, hay \$8 per ton, manure 40 cents per ton, rock phosphate \$10 per ton, and acid phosphate \$20 per ton.

TABLE I. CROP VALUES AND INCREASES FOUND IN FERTILIZER TRIALS  
MADE AT THE MORRIS EXPERIMENTAL FARM IN 1915-1917

Treatment	Corn		Wheat		Oats		Clover	
	Yield	Value	Yield	Value	Yield	Value	Yield	Value
No fertilizer.....	Bu. 36.0	\$21.60	Bu. 23.1	\$23.10	Bu. 64.9	\$25.96	Tons 2.07	\$16.56
Rock phosphate.....	37.2	22.32	24.0	24.00	68.8	27.52	2.87	22.96
Rock phosphate and manure.....	42.2	25.32	25.7	25.70	71.4	28.56	2.97	23.76
Manure.....	41.9	25.14	24.9	24.90	71.4	28.56	2.6	20.80
Acid phosphate and manure.....	41.9	25.14	26.4	26.40	69.6	27.84	2.89	23.12
Acid phosphate.....	40.5	24.30	27.2	27.20	70.8	28.32	2.79	22.32

Treatment	Value of crops in rotation	Increase in value from fertilizer	Cost of fertilizer for 4 years	Increase in crop value above cost of fertilizers
No fertilizer.....	\$87.22			
Rock phosphate.....	96.80	\$9.58	\$10.00	\$ -0.42*
Rock phosphate and manure.....	103.34	16.12	13.20	2.92*
Manure.....	99.40	12.18	3.20	8.98
Acid phosphate and manure.....	102.50	15.28	8.00	7.28
Acid phosphate.....	102.14	14.92	4.80	10.12

\* A minus sign indicates loss.

## ACID PHOSPHATE TRIED ON STEVENS COUNTY FARMS

From the results of these experiments there appeared to be no doubt about the value of acid phosphate on soil similar to that of the plot land on the Morris farm. A detailed soil survey of Stevens County had been started in 1917 by the Division of Soils of the Central experiment station and the Bureau of Soils of the United States Department of Agriculture, assisted by the Morris station, and it had become evident that the most extensive soil type in the county was that represented by the plot land on the Morris farm. Hence it appeared probable that similar profitable results would be obtained with acid phosphate on many of the farms of the county. Accordingly, experiments were arranged with two groups of co-operators, one consisting of thirteen Stevens county landowners and the other of seven former students of the West Central School of Agriculture.

The members of the first group purchased their phosphate, from 1 to 5 tons each. One of the writers selected the fields, trying to avoid all land that had received manure within the last four or five years, and accordingly the fields represent land in a state of productivity somewhat lower than the average for the county. Some of the fields had received no manure since they were first plowed, from twenty to thirty-five years ago. The phosphate was applied by members of the experiment station staff, part of each field being treated at the rate of 200 pounds per acre. The line between the treated and the untreated portion was marked with stakes. The two parts of the field received the same cultivation, and were seeded alike and at the same time, thus permitting a direct comparison of the yields. The fields ranged in size from 1 to 30 acres.

## Weather Prevents Trials With Clover

As the beneficial effect of phosphate on clover had been so marked on the Morris farm and as comparatively little of this crop is now grown in the county, coöperative experiments including it were desired. The dry season of 1917 followed by the very severe winter of 1917-1918 had killed

out practically all the clover in the county and so arrangements had to be made for seeding in 1918 to secure data in 1919. This experiment promised to cause more inconvenience and expense to the coöperators than the preceding one and to meet this situation the Extension Division offered to furnish 400 pounds of acid phosphate to each coöperator, this to be applied at the rate of 200 pounds per acre to each of two one-acre plots, two similar unfertilized plots being retained as checks, as shown in Figure 2.

Plot 1	Nothing
Plot 2	200 lbs. Acid Phosphate
Plot 3	Nothing
Plot 4	200 lbs. Acid Phosphate

Fig. 2. Arrangement of the Four One-Acre Plots as Used by the Second Group of Coöperato

The small grain was to be seeded with clover, the latter to be left for hay in 1919 and the crops from the four plots harvested separately in both years. Seven former students of the West Central School of Agriculture were secured as coöperators. The summer was exceptionally dry, so that on not one of these fields has a satisfactory stand of clover been secured.

All but one of the fields were inspected by the writers several times between seeding and harvest. In nearly all cases during the early stages a marked difference in growth could be observed between the two portions of the field, the treated portion being the better. Later, when the grain was heading out, this difference was not so marked and in some fields had disappeared, but even at the time of harvest in many cases it was possible to follow the whole length of the line between the treated and the untreated areas, the grain maturing earlier, appearing heavier, or both.

#### Most of the Fields Show Phosphate Profitable

The grain yields from the two groups are reported in Table II, which gives the name of each coöperator as well as the township in which his land is located, the crops grown, the yields per acre, and the size of the tracts compared. The fields are arranged in the order of the gains to be attributed to the phosphate, the one showing the highest being given first.

It will be seen that of the fourteen farmers who tried the phosphate on wheat, nearly all secured a marked increase, the gains ranging from 2.1 bushels to as high as 10.5 bushels per acre.

In the case of field 15, no weights were obtained, the owner seeing little or no difference between the treated and untreated portions and considering it not worth while to harvest and thresh the two portions separately.

TABLE II. YIELDS OF GRAIN ON STEVENS COUNTY PHOSPHATE DEMONSTRATION FIELDS IN 1918

No.	Owner	Township	Yield per acre		Area of portion		Increased yield per acre
			With phos- phate	With- out phos- phate	With phos- phate	With- out phos- phate	
WHEAT							
1	W. Brisbane	Framnas	Bu. 27.5	Bu. 17.0	Acres 2.0	Acres 2.0	Bu. 10.5
2	Adams Land Co.	Synnes	30.4	20.0	10.0	25.0	10.4
3	Mac M. Davis	Donnelly	31.1	23.4	3.5	4.5	7.7
4	J. C. Phifer	Donnelly	19.4	13.2	11.0	14.0	6.2
5	J. P. Steinfert	Pepperton	24.1	17.9	8.5	21.5	6.2
6	P. S. Jordan	Donnelly	19.0	13.0	22.0	25.0	6.0
7	R. W. Keeler	Stevens	25.0	20.5	2.0	2.0	5.5
8	Geo. Pushor	Donnelly	15.7	10.7	2.0	2.0	5.0
9	Mac M. Davis	Donnelly	25.2	20.8	5.0	1.5	4.4
10	E. E. Walpole	Moore	15.5	11.7	11.0	11.0	3.8
11	O. Solvie	Hodges	23.7	20.1	1.0	1.0	3.6
12	F. Mahoney	Horton	16.5	13.0	2.0	2.0	3.5
13	L. Kolodgy	Donnelly	32.0	28.5	2.0	2.0	3.5
14	Adams Land Co.	Donnelly	15.4	13.3	12.0	8.0	2.1
15	F. W. Biesterfield	Moore			10.0	15.0	
16	C. C. Ersted	Rendsville	16.8	20.3	5.0	0.5	3.5*
BARLEY							
17	C. C. Ersted	Rendsville	33.4	25.4	5.0	12.0	8.0
18	J. H. Devenney	Framnas	31.4	24.2	14.0	1.0	7.2
19	E. J. Jones	Morris	12.5	7.9	38.0	1.5	4.6
20	Adams Land Co.	Donnelly	14.5	10.1	8.0	15.0	4.4
21	A. Overstad	Moore	42.2	37.9	4.0	1.0	4.3
22	J. E. Peterson	Rendsville	26.0	28.1	9.5	6.5	2.1*
23	F. A. Hancock	Morris	19.6	15.5	17.0	2.0	4.1
OATS							
24	F. A. Hancock	Morris	30.8	31.2	21.0	2.5	0.4*
25	N. P. Mecklenberg	Moore	28.8	33.6	10.0	8.0	4.8*

\* In the case of these fields a lower yield was obtained on the portion of the field that received the phosphate.

### Some Fields Show no Gains

Only two fields were seeded to oats and neither showed an increase. From Table II it will be seen that of the four crops grown in the rotation on the Morris experimental farm, oats is the one showing the smallest benefit from phosphate. Hence it was not surprising to obtain less favorable results with this crop in the fields of the coöperators. A word of explanation is desirable in the case of field 25, in which, through a misunderstanding, a fair comparison of the yields from the fertilized and unfertilized portions can not be made. A portion of the field had been manured a year or two before and the phosphate was applied to a part of the unmanured portion, the intention being to harvest and thresh separately the ten acres treated with phosphate and the part of the field that had received neither manure nor phosphate. Unfortunately, the grain from the whole of the portion of the field receiving no phosphate was

stacked together. The crop on the part receiving phosphate ripened and was in shock before that on the rest of the field was fit to be cut.

One condition experienced in the past season's work, especially unfavorable to showing the maximum benefit to be derived from the acid phosphate, should be mentioned. Owing to the scarcity of phosphate and the congestion of railroad traffic, the fertilizer was so late in reaching Morris that on many of the fields it was necessary to apply it after the grain was up and on only a few of these was it harrowed in.

#### **Profit From Phosphate Not All in First Year**

The profits from the phosphate in the first year may easily be computed by the reader for himself, remembering that this fertilizer cost \$25.40 per ton delivered at Morris and that the amount per acre used was 200 pounds, or \$2.54 worth. The only additional expense was that incurred in hauling the phosphate from the railroad station and scattering it over the field. Only a part of the favorable effect, if any, of the phosphate will be shown in the first year and the total beneficial effect during the first four years after its application may amount to two or three times as much as that shown in the year of application.

In order to determine the residual effect of the phosphate, the fields will be kept under observation for the next year or two years.

At the time of writing (November, 1918), the cost of both acid phosphate and the sacks used as containers is abnormally high, making the price about \$30 per ton for carload lots delivered at Morris. Before the war it could be obtained there at from \$18 to \$20 per ton, and it is probable that the price will now rapidly fall.

#### **Trials so Far Confined to Heavy Soils**

It should be emphasized that the profitable results reported both in Table II and in the report of the Morris substation have been obtained only on the heavy types of soil, and on these only in the absence of an application of manure. The experiment station has conducted no phosphate experiments on the sandy soils of the western part of the state with the exception of field 19, reported in Table II. Light soils, in general, respond less to phosphate fertilizers than do the heavier types.

#### **Manure or Phosphate, Not Both at Same Time**

There is little probability of profit from using phosphate in conjunction with manure on the heavier soils of Stevens County, judging from the results of the experiments conducted on the Morris experimental farm. Where an application of 8 tons of manure per acre has been made once in four years, practically the same yields have been secured without the phosphate as with it. (See Table I.) Fields that have served recently as pastures may be expected to behave like the manured fields.

### **FARMERS OF STEVENS AND ADJACENT COUNTIES ADVISED TO TRY PHOSPHATE**

No heavy investments in phosphate are suggested, but the results of the experimental work in Stevens County to date make it appear a wise business measure for those farmers of Stevens and the immediately surrounding counties who have heavy soils on which some fields have received little or no manure, to apply on one of these half a ton or more of acid

phosphate at the rate of 200 pounds per acre, using wheat or barley as the trial crop and preferably seeding with clover. From the way in which such a fertilized portion produces during the next three or four years the farmer will be able to decide for himself whether phosphate is profitable on his farm.

As a trial area it is far better to use only a part of a field than the whole, and it is also better to have the fertilized portion run the whole length of the field, preferably through the center, with unfertilized portions on both sides.

### PHOSPHATES UNPROFITABLE IN MANY PARTS OF MINNESOTA

Any farmer in another part of the state than the west central who may read this and be interested in the question of the profitable use of phosphates on his own farm, should not be influenced by the reports of the Stevens County experiments without first learning the results obtained in other parts of the state, as reported in Special Bulletin No. 23 of the Agricultural Extension Division, "Experiments with Phosphate Fertilizers in Minnesota," which may be obtained by writing to the Office of Publications, University Farm, St. Paul.

The 1918 report of the Morris substation will be ready for distribution early in 1919 and copies may be obtained by addressing the West Central Substation, Morris, Minn.

A list of the Publications of the  
AGRICULTURAL EXTENSION DIVISION  
may be obtained by writing to the  
Office of Publications, University Farm, St. Paul